

sunshine averaged 88 per cent of the possible amount. There were 15 days with 100 per cent of sunshine and none without some sunshine. The wind movement was below normal, especially at night, and there were no high winds.

The effects of the drought upon vegetation were not noticeable until the middle of August, when the abnormally low moisture content of the air began to hasten the exhaustion of surplus moisture and prevent the usual copious deposits of dew. During the latter part of August the deterioration was rapid. Grasses, especially the Bermuda grass of the city lawns, were first affected, and the lawns had assumed their midwinter lifeless appearance by August 31. The soil became dry to an average depth of 6 or 8 inches; and for fully three weeks the country roads and some of the unpaved city streets were almost impassable on account of dust.

The drought occurred too late in the season to cause such radical injury to cotton as had been suffered in a number of previous years, notably 1896 and 1911, the season's loss, estimated by competent authorities, being about 30 per cent of the normal crop. Though the season's fruit crop was uninjured, it is believed that the negligence of fruit growers in failing to cultivate the orchards and the strawberry beds during the critical period will materially reduce next season's crops, and may result in the ultimate loss of a number of trees. The damage to the corn was about 40 per cent and to late potatoes 50 per cent of the normal crops. Owing to lack of moisture very little late garden truck was planted, and that planted was nearly a total loss.

The volume of water in the Arkansas River was the smallest in many years, though the records show lower gage readings. There were places where the river was only 15 or 20 yards wide and easily fordable. There was, however, little suffering or inconvenience on account of depleted water supplies. The Poteau River, from which the city of Fort Smith is supplied, was exceedingly low, but auxiliary pumps prevented serious inconvenience, except during the two or three days consumed in placing the pumps in service. The water supply in wells and small creeks became low, but it was not wholly exhausted at any time.

Neither the intense, protracted heat nor the extreme dryness produced any marked physiological effects. The heat, accompanied as it was by low humidity, caused little physical discomfort and no sunstrokes. There were, however, a few days with heavily dust-laden atmosphere, and this was the only really disagreeable feature.

#### DROUGHT AND HEAT WAVE OF 1913 IN IOWA.

By GEORGE M. CHAPPEL, Section Director.

The year 1913 will be noted for its long-continued high temperatures and droughty conditions, especially over the southern half of the State, but in several respects the adverse conditions were not as well marked as in the memorable years of 1894 and 1901. Considering the combination of high temperatures and lack of moisture the summer of 1894 was the severest in its effects on staple crops ever experienced in this State, although the temperature was not as high nor were there as many days with readings of 90° or above as there were in 1901, which was the hottest summer on record for this section.

This year the temperature was above the normal nearly all the time from June 13 to September 7, inclusive.

August was warmer than July, and the first week of September was the hottest ever recorded in that month, and over much of the State it was the hottest week of the season. The rainfall was below the normal for each of the summer months, but as there had been an excess of precipitation during March, April, and May, the high temperatures during the latter half of June and the first half of July were considered favorable for the staple crops, and corn probably never made a more rapid growth than during the last 15 days of June, but owing to the cold and backward spring and the adverse conditions during the planting season and the average condition of corn on July 1 was only 93 per cent as compared with the average of past years on that date, as shown by the reports of the Iowa Weather and Crop Service.

July was the warmest month of that name since State-wide observations began in 1890, except in 1894 and 1901, and it was the driest since 1894. There was an average deficiency of rainfall for the State of 2.62 inches, but over the southwest quarter and practically all of the north half of the State there was sufficient moisture to keep corn in fine condition, but at the close of the month pastures, potatoes, and garden truck were in need of rain. In the southeastern counties where the average precipitation for the month was only about 0.25 inch, and where several stations within that area reported only a trace during the entire month, pastures were bare, corn was seriously injured, and water for stock was getting scarce. The excessively high temperatures that prevailed for the four days July 13 to 16 were injurious to corn in that it damaged the pollen and prevented perfect fertilization.

The high temperatures and lack of moisture continued during August, but these features were more pronounced in the southern than in the northern part of the State. While the northern section had an excess of 3.4° in temperature and a deficiency of 0.61 inch in rainfall, the southern section had an excess of 6.4° in temperature and a deficiency of 2.13 inches in precipitation. These departures were still more marked in the southwestern counties, where it was the warmest August on record, and one of the driest. The excessive heat was almost continuous throughout the month, and on many days the maximum temperature readings were near or above 100°. At Northboro, Page County, the maximum temperature was 90° or higher on 29 days and 100° or higher on 16 days. The precipitation came in local showers which were poorly distributed geographically, and throughout the month. Thurman, in Fremont County, recorded only 0.08 inch, while Winterset, in Madison County, recorded 7.13 inches, and in Pocahontas, Palo Alto, Clay, and Dixon Counties the monthly amounts ranged from 5 inches to 6.99 inches. While there was a generous amount of moisture over a large part of the State, its beneficial effect was only temporary, as the hot, dry winds caused rapid evaporation, and at the close of the month all vegetation was suffering for water. Wells were failing and small streams were dry in the southern part of the State, and in many localities stock was being fed as in winter on account of the lack of pasture.

Excessively high temperatures and almost a total absence of rainfall prevailed during the first seven days of September. It was, in fact, the hottest week ever recorded in the State in September. The daily maximum temperatures were above 90° in practically all sections, and in the southern counties they were 100° or higher. The intense heat, bright sunshine, and brisk winds absorbed what little moisture there was left in the ground

and vegetation. Corn was rushed to maturity prematurely, and late potatoes were considered almost a failure. The ground was too hard and dry to permit plowing, and as a result its preparation for winter wheat was greatly delayed.

#### THE DROUGHT OF 1913 IN TEXAS.

By B. BUNNEMEYER, Section Director.

Droughty sections of Texas, while they may form a large portion of the State in the aggregate, are usually interspersed with areas of greater or less dimensions that have not suffered materially from lack of precipitation. In so large a State with its varying geographical features and climatic conditions, it is not likely that any considerable area should go entirely without moisture for so long a time as two months. Individual localities, however, may go without precipitation for even longer periods, while neighboring sections during the same time may have been well supplied with moisture, due to the fact that the summer rainfall occurs nearly always in local showers. Independent of the deficiency of precipitation the severity of a drought depends largely upon its effect on animal and plant life. The mere absence of rainfall for any protracted period may do no harm if the ground be well soaked previously, as many plants, and especially cotton, seek the moisture in the subsoil, and can therefore live for some time after the surface soil may have become pulverized from the dryness.

#### CONDITIONS PREVIOUS TO DROUGHT.

The winter of 1912-13 started in auspiciously with well-timed rains that put a good season in the ground, the amount of moisture received during the winter months averaging 0.78 inch more than normal for Texas as a whole. A decided setback occurred during the spring months, which normally constitute the wettest season of the year, but in this case showed a total shortage of 2.59 inches. No material harm resulted, however, as there was not only considerable moisture in the ground from the winter rains, but also the precipitation was well distributed, because the monthly amounts increased as the weather grew warmer and more moisture was needed. The average precipitation for March was 1.69, for April 2.02, and for May 2.55 inches, and although these amounts were below the normal they were encouraging and kept the husbandman in good spirits. June added decidedly to the prospects, with a total rainfall of 3.61 inches, which exceeded the normal by 0.18 inch, and optimistic crop reports came in from all sections.

#### DURATION AND AREA OF DROUGHT.

The month of June closed with splendid showers, and showery conditions continued until July 5, which marks the inception of the drought, although the dryness was not seriously felt during the succeeding two or three weeks on account of the preceding good rains. Droughty conditions continued until September 6, when a showery area overspread the State, which continued for several days and culminated in general and heavy precipitation. It is difficult to define the exact limits of the drought-stricken area for reasons already explained in the introductory remarks. Nearly all sections of the State suf-

fered at some time between July 5 and September 6, but in the main the area of least precipitation embraced the central and southwestern portions of the State in July and the northern portions in August, although in either month there were scattered sections in other portions of the State that also received little or no moisture.

#### PRECIPITATION.

The average rainfall for July was only 1.29 inches, notwithstanding the fact that record-breaking rains occurred during the opening days of the month in northeast Texas, centering around Hunt County, with amounts ranging from 5 to over 10 inches. There were also good local showers in the lower Panhandle and portions of northwest Texas. The August rainfall was slightly less than that of July, amounting to 1.26 inches, but there were beneficial showers in many central and southern counties, the shortage for the two months being 1.62 and 1.15 inches, respectively. While there have been three years since 1888 in which July was drier than in 1913, and four years in which August was drier, yet, taking the two months together, they were drier than any other corresponding period since 1888. All in all, there were 50 localities in various parts of the State that received no moisture, or at least not more than a mere trace, during one of the two months. Of this number 24 occurred in July and 26 in August. At four of these stations, located in Burleson, Callahan, Duval, and Nueces Counties, there was no precipitation during either month. The average number of days with 0.01 inch or more of precipitation was small, being only two in July and four in August, and there was a correspondingly large number of clear days, amounting to 21 for July and 18 for August. The number of clear days in July broke all previous records.

#### TEMPERATURE.

An aggravating factor of the droughty condition was the persistently high day temperatures coupled with excessive sunshine, which caused the ground to dry rapidly after any occasional showers. From July 5 to September 6 the highest daily temperatures averaged as follows: 94° on 9 days, 96° on 26 days, 98° on 23 days, and 100° on 6 days.

Temperatures at individual stations ran much higher in the northern and northwestern portions of the State, the highest reported for July being 110° at Graham, Denton, and Jewett; and for August, 110° at Graham, and a number of stations had an average maximum temperature of 100° or slightly higher.

The mean temperatures for July and August, while 1.2 and 1.4°, respectively, above the normal, were not as high as recorded in some previous years. Since 1888 there were six years in which July was warmer and seven years in which August was warmer. The warmest July was that of 1909, with an average excess of 2.4°, and the warmest August that of 1902, with an average excess of 3.6°; but there was probably no year in which the temperature was more evenly and persistently high. The year 1909 was droughty, while 1902 was wet, although August of that year was exceedingly dry, with a total rainfall of only 0.30 inch, which is the lowest of record for that month. The month was, however, preceded by an unusually wet July and followed by an unusually wet September.